The genus *Melanocharis* comprises four species, all from New Guinea and its islands. These are not very dissimilar in size or coloration. The best known, well named *M. nigra*, is a glossy black above of a bluish cast. Beneath the principal tint is olivaceous, passing into pale yellow on the abdomen. The under wing-coverts are white. Total length, nearly five inches.

Another genus of the same family, consisting of but a single species, is *Pristorhamphus veroteri*. A larger bird this by an inch, with rich, velvety black plumage above, emanating pale green. Underneath a bluish tint. Besides, some spots of white on the tail, apparent when the bird is flying, but concealed at other times; there are white plumes, very soft and delicate, waving on either flank. The female is equipped with these same adornments, but is of dimmer coloring, mainly olivaceous. Habitat, the Arfak Mountains.

Less by more than an inch is *Rhamphocharis crassirostris*, the sole member of its genus. An olive-green bird above with dusky brown wing- and tail-coverts, and blackish tail. Below the body is a pearl-gray with a yellow wash. The female is of larger size, olive-brown above, but differing from the male in being rather more varied in neutral colors, yellow and white spots or dots appearing on the dull surface of wings, tail and back. The under parts are of a soiled white, specked with yellow and brown. The bill is not noticeably larger than that of other species.

THE BACTERIAL DISEASES OF PLANTS: A CRITICAL REVIEW OF THE PRESENT STATE OF OUR KNOWLEDGE.

By Erwin F. Smith.

II.

I. THE BEET (BETA VULGARIS L.).

1. THE BACTERIOSIS OF FODDER BEETS (1891).

(I) The disease.

(1) *Author, Title of Paper, Place of Publication, etc.*—This disease was first described by Dr. Ernst Kramer, Privat Docent

in the technical high school in Graz. His paper entitled (**23**) Die Bacteriosis der Runkelrübe (*Beta vulgaris* L.), eine neue Krankheit derselben, was published in *Oesterreichisches Landwirtschaftliches Centralblatt*, Jahrg. I, Heft 2, pp. 30 to 36, and Heft 3, pp. 40 to 41. Graz, 1891.

(2) *Geographical Distribution.*—The disease prevailed extensively in 1890 in the Eltzischen earldom in Vukovar, Slavonia.

(3) *Symptoms.*—The beet roots were said to be shrivelled and to contain comparatively little sap. The whole of the affected roots began to change to dark brown soon after harvest. On cutting them open dark brown spots were visible. During the winter the disease spread in the beet cellars to apparently sound beets, in spite of the fact that all roots showing any signs of disease were thrown out and destroyed at the time of storage. Roots in which the disease was well advanced showed a gummy ooze which appeared to be infectious to sound beets. Cattle fed with slightly infected roots were attacked with severe bloating and obstinate constipation, and in one case death ensued. Such was the account forwarded to Dr. Kramer along with samples of the diseased beets. There is no record of the symptoms of this disease as it occurs in the field. The diseased beets received by Dr. Kramer were shrunken and in some places were soft under the epidermis. From these soft places there oozed a slimy brownish fluid, which stuck to the fingers, but was without characteristic smell or taste. Brown or dark brown spots more or less softened, and of various sizes, were visible on cross-sections of roots not too badly infected. The inside of those specimens which were badly attacked was, however, almost entirely brown, and in parts the parenchyma was wholly destroyed, giving place to a slimy, sticky, gum-like, brown-colored, strongly acid, odorless fluid. The destruction of the tissues proceeded so far in some parts of the root that, finally, only the vascular bundles remained. The beets attacked by this disease yielded no characteristic odor, and they only began to smell bad in the last stages of the disease after rotting had set in.

(4) *Pathological Histology.*—An examination of thin sections, made through a brown spot, showed that the cells of this

parenchyma contained tiny roundish or ellipsoidal shining bodies, which were of various sizes, and either scattered about in the cells or united into groups. The individual particles showed not rarely a tremulous motion. When such a thin section was fixed to a cover glass by passing it three times through the flame, and was then stained with gentian violet, these bodies became a beautiful blue, and their bacterium-like form could be made out more clearly. In the parts of the root which had already become slimy great numbers of bacteria were to be seen in the gum-like fluid, together with loosened cells, plasma, and fragments of cell membranes.

(5) *Direct Infection Experiments.*—When a little of the soft, slimy mass was lifted on a sterile platinum needle and spread on a sterile [steamed ?] section taken from an apparently sound beet, the surface of the latter was covered within forty-eight hours with a slimy, brown, gum-like, acid layer, which consisted of a mass of those bacteria previously found in the diseased beets. Sections cut out of diseased beets with sterile knives and placed on fresh, unsterilized sections from sound beets, and kept in a moist chamber at 24° C., caused the latter to become affected. The infected spots browned and softened, and in the tissues bacteria appeared, which were just like those occurring in the diseased beets. A slimy layer also formed on the sterile cut surface of carrots when a slight quantity of the slimy ooze from the beets was spread over it.

"This preliminary investigation indicated that most likely in this case we have to do with a disease caused by bacteria. Positive proof, however, is not thereby afforded. To accomplish this experimentally it is absolutely necessary to isolate the bacteria occurring in the diseased beets, to cultivate them pure, and then to inoculate the pure cultures into sound living beets. If then as a result of the infection the previously healthy beet should become diseased with the before-mentioned symptoms, and the originally inoculated bacteria should appear once more in the tissues, then there would be no doubt about this being a bacteriosis of the beet."

Clearly this man knew exactly what he had to do.

(II) THE ORGANISM.—This is described as a bacillus, but not named.

(1.) *Pathogenesis.*

(A) Yes.

(B) Yes. Rather easy.

(C) No. These inoculations led to no satisfactory result, and had to be abandoned, because no suitable beet material was at the experimenter's disposal.

(D) No.

Conclusion.—Pathogenic nature rendered probable. The reason for this judgment in opposition to the above statements will be found in the following paragraph.

While Dr. Kramer was not able to secure infections, owing probably to the unfavorable conditions under which he worked, he hit upon an ingenious method of indirect proof, viz., the development in pure cultures of the same gum which is formed naturally in the diseased beets. His method was as follows: The softened or liquefied parts of the diseased beets were cut out, crushed and heated on a water bath, with the addition of a small quantity of milk of lime. The fluid was then decanted, and the remaining mass of beet squeezed as dry as possible and the two fluids mixed, filtered, and carbon dioxid passed into the filtrate for the removal of the somewhat superfluous lime. The fluid was again filtered and concentrated on the water bath. The fluid was now rendered acid by the addition of some drops of acetic acid, and a white, tough, gum-like substance was precipitated out of it by the addition of 96 per cent. alcohol. To obtain it in a pure condition this substance was repeatedly dissolved in water and reprecipitated by alcohol. The same substance was obtained directly from the gummy ooze of the diseased beets by dissolving it in water, heating, filtering, concentrating on the water bath, and precipitating with alcohol. In this case also the precipitate was a white, tough, gum-like substance. Both of these precipitates were tested chemically with the following results. Mixed with soda-lime and heated in a test tube there was no formation of ammonia, a proof that the substance was free from nitrogen. Boiled with orcin and hydrochloric acid it gave the well-known gum reaction, men-

tioned by Reichl and Wiesner. Boiled with sulfuric acid it was converted into dextrose. A watery solution gave a bluish flocculent precipitate with Fehling's solution, and on boiling the latter was reduced. On the addition to a watery solution of ferric chlorid and calcium carbonate the well-known precipitate of gum solutions resulted. No red coloration appeared on treatment with iodin. The formation of oxalic acid could not be detected on long boiling with nitric acid. All these reactions indicated a gum. In the beet this could be derived only from carbohydrates, and most likely from dextrose. Working on this hypothesis, a fluid culture medium was prepared containing 3–4 per cent. of dextrose, a slight quantity of peptone, and the necessary mineral ingredients. In this solution pure cultures of the organism were grown 8 to 14 days at a temperature of 24° C., and from the resulting products of growth a gum-like substance was obtained which proved to be identical with that secured directly from the diseased beets. These cultures were protected from contamination by cotton plugs, and at the close of the experiment cultures therefrom showed them to have remained pure, consequently this bacillus must have converted the dextrose into gum.

2. *Morphology.*

(1) *Shape, size, etc.*—The organism as isolated and grown in pure cultures is a thick rod with rounded ends, or often narrowed at the ends (zugespitzt), of variable length, so that not rarely coccus or ellipsoidal forms appear. These rods are about 1.30–2.00 x 0.7–1.0 μ. In cultures they occur singly or in pairs, which latter are more or less biscuit-shaped. Chains are rarer.

(2) *Capsule.*—No mention of any capsule.

(3) *Flagella.*—No statement as to motility, except mention of the trembling motion inside the cells of the beet, which can scarcely be taken as a proof of motility.

(4) *Spores.*—"Apparently spores are formed." This matter is left in considerable doubt. Rods in the stage of spore formation are said to be 1.35 x 2.00 μ.

(5) *Zooglœa.*—No mention of zooglœa.

(6) *Involution forms.*—No mention of any distorted forms.

3. *Biology.*

(1) *Stains.*—These bacilli take all the ordinary anilin colors.

(2) *Gelatin.*—On plate cultures of nutrient gelatin containing dextrose the colonies are small, nearly circular, sharply contoured, white, shining, and at most not over 1 mm. in diameter. Under a weak magnification they appear sharp-edged, granular and brownish. Stab cultures in the same gelatin show a fine thread not spreading beyond the needle track. At the mouth of the stab there is a top-shaped enlargement not inclined to spread out much. Streak cultures on nutrient gelatin develop a line along the track of the needle which is very slightly inclined to widen. This is formed of dot-shaped hyaline colonies, which finally fuse. The bacillus does not liquefy gelatin.

(3) *Agar.*—Plate, stab and streak cultures on nutrient agar were not unlike those on the gelatin. Exact statements as to the composition of the nutrient gelatin and agar are not given.

(4) *Potato, etc.*—Pure cultures on sterilized slices of beet gave a brownish, slimy growth, having a strongly acid reaction. The same on carrot gave a whitish, slimy layer, having a strongly acid reaction. On potato the growth showed no specially characteristic mark, but was strongly acid.

(5) *Animal Fluids.*—No statement.

(6) *Vegetable Juices.*—No statement.

(7) *Salt Solutions and other Synthetic Media.*—The 3–4 per cent. dextrose-peptone solution (distilled water?) containing the necessary mineral ingredients (not named) became cloudy in forty-eight hours and less limpid in 8 to 14 days.

(8) *Relation to Free Oxygen.*—Aerobic.

(9) *Reducing and Oxidizing Power.*—No statement.

(10) *Fermentation Products, and other Results of Growth:*

(a) *Gas Production.*—No statement. If the cattle disease were really due to this organism, then we may suppose it to be an active gas producer in the presence of certain carbohydrates.

(b) *Formation of Acids.*—This bacillus is a strong acid producer. The sap of the diseased beets shows a strong acid reaction. Pure cultures strongly reddened blue litmus gelatin in

forty-eight hours, and developed an acid reaction in neutral nutrient solutions within a few days. The composition of these solutions is not stated, nor whether the growth of the organism is self-limited by the production of the acid. This production of acid serves to strengthen the belief that the bacillus is really the cause of the beet disease. The nature of the acid was not determined.

(c) *Production of Alkali.*—Not recorded.

(d) *Formation of Pigment.*—Brownish color on beets.

(e) *Development of Odors.*—No odor.

(f) *Enzymes.*—Not determined. Cell walls are dissolved.

(g) *Other Products.*—Not stated.

(11) *Effect of Dessication.*—No statement.

(12) *Thermal Relations:*

(a) *Maximum for Growth.*—Not determined. If the bloating of the cattle were due to this organism, it must be able to grow at blood heat, and the accurate determination of its thermal relations should not have been omitted.

(b) *Optimum for Growth.*—Not determined.

(c) *Minimum for Growth.*—Not determined.

(d) *Death Point.*—Not determined.

(13) *Relation to Light.*—No statement.

(14) *Vitality on Various Media.*—No statement.

(15) *Effect on Growth of Reaction of Medium (acid, neutral, alkaline).*—No statement.

(16) *Sensitiveness to Antiseptics and Germicides.*—No statement.

(17) *Other Host Plants.*—No statement.

(18) *Effect upon Animals.*—No cattle could be had for experimental purposes; but the germ was carefully tested on rabbits and white mice, and was not pathogenic either when fed to them in carrots, rubbed into subcutaneous wounds, or injected into the blood by means of a Pravaz syringe.

(III) ECONOMIC ASPECTS:

(1) *Losses.*—Serious.

(2) *Natural Methods of Infection.*—Not known.

(3) *Conditions Favoring the Spread of the Disease.*—Not known.

(4) *Methods of Prevention.*—No experiments, and no observations. Disease not studied in the field.

Remark.—This disease was also seen in 1891 by Dr. Paul Sorauer, who described it as follows, in a short note appended to a (**24**) "Review" of some papers on the Sereh-disease of sugar cane (*Zeitschrift für Pflanzenkrankheiten*, Bd. I., Heft 6, 1891, p. 360). "We can now report similar phenomena in our *Beta*. A parcel of beets sent to us from Slavonia were suffering from a disease which may be designated *gummosis*. Investigations up to this time have shown that the bacteria induce the formation of a syrup-like gum. Here also the first indications of the disease are a red-brown, subsequently a black-brown, staining of the vascular bundles, and each drop of gum swarms with myriads of apparently specific bacteria. If this gum is dropped upon sliced (*praeparierte*) sound beets the bacterial gummosis is there easily produced. The preparation of the beet so as to be susceptible to the disease appears to lie in a lessening of the acidity of the tissues, etc." No strictly bacteriological work appears to have been done, and I have quoted all of the article that is pertinent.

2. THE ROT OF SUGAR BEETS (1891).

In 1891, in (**25**) *Fungous Diseases of the Sugar Beet*, Bull. No. 15, Iowa Agric. Experiment Station, Ames, Iowa, p. 243, Reprint p. 9, Prof. L. H. Pammel, of that station, described a beet disease from Iowa which he attributed to the fungus *Rhizoctonia betæ*.

Associated with this fungus were various bacteria to which he ascribed the subsequent wet rotting of the roots. The rotting beets gave off a strong odor not unlike that of rotting potatoes. Unquestionably "the ultimate rotting is caused by bacteria." Several bacteria were isolated, and among others *Bacillus subtilis*. Inoculations with a pure culture of one of these organism did not give any very decisive results. No bacteriological studies of any consequence seem to have been made.

3. A BACTERIAL DISEASE OF SUGAR BEETS (1892).

(I) THE DISEASE.

(1) *Author, Title of Paper, Place of Publication.*—This disease was described by Dr. J. C. Arthur and Katherine E. Golden, of

the Purdue University Agricl. Experiment Station, Lafayette, Indiana, in (**26**) *Diseases of the Sugar Beet*, issued April 13, 1892, and forming Bulletin No. 39, Vol. 3, of that station, pp. 54–58, and summary, pp. 61–62.

(2) *Geographical Distribution.*—This disease appeared in sugar beets grown for experimental purposes at the Indiana station, and seems to have first attracted the attention of the station chemist owing to the low percentage of sugar found in some of the roots. These were examined microscopically, and bacteria, or bacteria-like bodies found in the tissues. This was in 1890. "Owing to the lateness of the season, and the lack of a plant house, the observations on the disease soon came to an end, to await the next growing season. The following description of the disease, and of its distribution and cause, is therefore the result of studies made almost wholly during the summer of 1891 and the winter of 1891–2." The disease is prevalent in many places in Indiana. In 1892 it occurred in all of the eight varieties of sugar beets grown on the Purdue Station grounds, and was found to some extent in nineteen of the twenty-seven samples of beets sent in for analysis from as many different localities in that State. This is not, however, it is stated, an entirely fair indication of the prevalence of the malady, since it is customary to select the best beets for analysis, and the proportion of diseased ones in such lots is less than the actual average. Of a total of 434 beets received from different parts of Indiana, and examined for this disease, 12 per cent. were affected. No record was kept of the percentage of diseased beets appearing on the experiment station grounds, but this is stated to have been large.

(3) *Symptoms.*—"This disease does not usually cause the death of the plants, any spots upon its surface, or any alteration or discoloration of the tissues."

"The beet root shows externally no marks by which the presence of the bacterial parasite can be detected; the most diseased and the strictly healthy roots cannot be separated by any external characters. This statement, however, does not apply to the leaves. While the plants are small, the foliage of healthy and diseased plants remain normal; but as the plants

reach full size, and especially as they approach maturity, those which are most affected can be told at a glance by the altered appearance of the leaves. The healthy beet leaf has a decidedly flat, uniform surface, while the diseased leaf is puffed out between the veins in little blister-like areas, giving the general appearance of the surface of a Savoy cabbage leaf. Diseased plants are necessarily less vigorous than healthy ones, and the fact is made apparent to the eye as the season advances, by the leaves becoming paler and smaller, and the outer ones dying away faster than upon healthy plants. All these indications taken together, most reliance being placed upon the crinkled surface, will enable one to select much diseased plants as they are growing in the field, with considerable certainty. But some roots not showing the foliage characteristics will also be found to be affected.

"Upon cutting across a root the most constant indication of the malady is a greater prominence of the fibres which form the concentric rings. In well-marked cases each microscopic bundle shows a dark dot, the circles of dots growing more distinct on exposure to the air. In less pronounced cases the woody fibres are merely yellowish, or even quite colorless, but more prominent after being exposed to the air for awhile than normal tissues. Furthermore, the diseased root is rather soft and tough, and of a yellowish-white color, while a healthy root is firm, somewhat brittle, and in color a clean white. It has also been found that diseased roots are lighter in weight than healthy ones." They also contain less sugar. The reduction in all cases being considerable, and in some cases amounting to nearly 50 per cent. This is "presumably due to the presence of the bacteria."

In a foot-note it is stated that the circles of dark dots are found in all sugar beets. "And yet the greater prominence which these dark spots assume on account of the disease, make them one of the most effective indications of its presence."

(4) *Pathological Histology.* — A microscopic examination showed the bacteria "throughout all parts of the root." "So far as observed the disease rarely or never breaks down the tissues or kills the plant."

"A section from any part of a diseased root, under a magnification of four or five hundred diameters, shows the presence of great numbers of bacteria." "These bacterial parasites of the beet are not few, or difficult of detection; but occur in great numbers in every cell of the plant, and are conspicuous under the microscope without staining or other special treatment. The more pronounced the disease the greater the number of bacteria. They are most abundant in the large, loose-celled tissue, lying between the fibrous rings of the root and in the similar tissue of the veins and midrib of the leaf. This tissue consists of parenchyma, in which the protoplasm lines the walls of the cells and stretches across in strings from side to side. The bacteria are largely imbedded in or attached to the protoplasm, but also occur in the cell sap, sometimes in large numbers. While the bacteria are most abundant and conspicuous in the colorless parenchyma, they also occur in the cells of the fibro-vascular bundles, and in the green cells of the leaf; in fact, as has already been said, in all parts of the plant."

(5) *Direct Infection Experiments.*—No direct inoculation, or grafting of diseased roots upon healthy ones, appears to have been tried.

(II) THE PARASITE. Organism not named.

1. *Pathogenesis.*

(A) Yes.

(B) Yes. Easily isolated. Plate method. From the deeper tissues of the roots only one form of microbe is obtained.

(C) No, or yes, doubtfully. "Inoculation with pure cultures into the beet root has been attempted, and results appear to show that the disease was transmitted; but the trials were few, and we desire to repeat them before further discussing this part of the subject."

(D) No.

Conclusion.—Pathogenic nature not established.

2. *Morphology.*

(1) *Shape, size, etc.*—The bacteria are all of one shape and appearance. They are nearly twice as long as broad, small,

oblong, colorless, usually occurring as colorless cells, although occasionally found in pairs. No measurements are given.

(2) *Capsule.*—Nothing.

(3) *Flagella.*—The organism is said to be actively motile when grown in a rich nutrient fluid. No statement regarding flagella; or as to motility when taken directly from the plant.

(4) *Spores.*—Said to be arthrosporous; but no details are given or proof advanced in support of this statement, which probably rests on no other foundation than that endospores were not observed. So far as known to the writer nobody has demonstrated the existence of arthrospores in any species of bacterium or bacillus.

(5) *Zooglœa.*—No mention of zooglœa.

(6) *Involution forms.*—No mention of involution forms.

3. *Biology.*

(1) *Stains.*—No statement respecting behavior toward stains.

(2) *Gelatin.*—"Upon neutral gelatine the bacteria at first form a whitish growth, which becomes pale yellow with age, and the gelatine is eventually liquefied. Upon acid gelatine the liquefaction proceeds much more slowly. In all cases the gelatine finally becomes alkaline, whether acid or neutral to begin with."

(3) *Agar.*—"Upon agar-agar the growth is about the same as upon acid gelatine."

No statement as to what nutrient substances were added to the agar or to the gelatin or as to the reaction of the agar.

(4) *Potato, etc.*—Behavior not stated.

(5) *Animal Fluids.*—Not stated.

(6) *Vegetable Juices.*—"Develop well in sterilized juice expressed from the sugar beet; but their development cannot be readily watched, as contact with the air causes the juice to turn dark or even black."

It is not stated whether the expressed juice was sterilized by steam heat or at ordinary temperatures by filtration.

(7) *Salt Solutions and other Synthetic Media.*—"In a Pasteur sugar culture the bacteria grow well, causing the liquid to become slightly turbid in twenty-four hours. As growth

goes on, the turbidity becomes greater, and again decreases until at the end of nine or ten days, when growth practically ceases, the liquid becomes clear, and a grayish sediment falls to the bottom of the tube."

No statement as to whether the sugar in this solution was broken up with the formation of an acid.

(8) *Relation to Free Oxygen.*—No statement. Certainly not anaerobic, from the ease with which cultures were obtained.

(9) *Reducing and Oxidizing Power.*—No statement.

(10) *Fermentation Products and other Results of Growth*:

(a) *Gas Production.*—No statement.

(b) *Formation of Acids.*—No statement.

(c) *Production of Alkali.*—Neutral or acid gelatin becomes alkaline. In view of this statement it would be interesting to know whether the juice from diseased roots is alkaline, or less acid than that from healthy roots.

(d) *Formation of Pigment.*—Old cultures on gelatin are pale yellow.

(e) *Development of Odors.*—No statement.

(f) *Enzymes.*—Gelatin is finally liquefied.

(g) *Other Products.*—No mention of any.

(11) *Effect of Dessication.*—No statement.

(12) *Thermal Relations:*

(a) *Maximum for Growth.*—Not determined.

(b) *Optimum for Growth.*—Not determined.

(c) *Minimum for Growth.*—Not determined.

(d) *Death Point.*—Not determined.

(13) *Relation to Light.*—No statement.

(14) *Vitality on Various Media.*—Not recorded.

(15) *Effect on Growth of Reaction of Medium (acid, neutral, alkaline).* Liquefaction of gelatin delayed by acidity.

(16) *Sensitiveness to Antiseptics and Germicides.*—No statement.

(17) *Other Host Plants.*—None recorded.

(18) *Effect Upon Animals.*—No statement.

(III) Economic aspects:

(1) *Losses.*—"A source of danger to the beet sugar industry of no inconsiderable moment." See also (I) (2).

(2) *Natural Methods of Infection.*—Not determined.

(3) *Conditions Favoring the Spread of the Disease.*—Not determined.

(4) *Methods of Prevention.*—No experiments recorded, and nothing known.

Remark.—From the statement quoted under *Pathogenesis* (*C*) one might infer this to be a preliminary paper, and it is possible that a subsequent one may clear up some of the many mooted points. At present the most that seems to be made out beyond doubt is that there is in Indiana a disease of sugar beets accompanied by decreased sugar content, and always or usually associated with minute bodies distributed pretty uniformly through the parenchymatic tissues, and believed to be bacteria. To the writer of this article the evidence that bacteria are really the cause of this disease does not appear to be very conclusive. Until more proof is advanced it is permissible to doubt (1) whether the organism isolated by plate cultures, and supposed to have been derived from the interior of the beets, was actually so derived; and (2) whether the bacteria-like bodies which "occur in great numbers in every cell of the plant," but which "never break down the tissues," or cause "any alteration or discoloration of the tissues," are really micro-organisms. To have every cell full of aerobic bacteria, and no lesions, is very remarkable, considering the nature of the plant cell, and certainly requires unusually strong evidence. Under the circumstances is it not possible that these bodies may be of a crystalline or crystalloid nature? This seems the more likely, from the fact that the juice of healthy table beets, the only sort the writer has been able to examine, is full of small particles endowed with active Brownian movement, and readily mistaken for bacteria when examined in hanging drops with medium magnifications. The uninjured parenchyma cells of the petioles were also found to contain these bodies in large numbers and in active motion. They stain slowly with alkaline methyl blue, and are not microörganisms.

4. THE DEEP SCAB OF BEETS (1891).

In (**27**) *Bulletin No. 4*, Agric. Experiment Station, North Dakota, Fargo, N. D., Dec., 1891 (pp. 15–17), Prof. H. L. Bolley,

of that station, described "a disease of beets indentical with deep scab of potatoes," which latter he attributes in another article in the same bulletin to "a bacterioid fungus-like affair having characteristics which would seem to ally it both to the fungi and to the bacteriaceæ." Inasmuch as this beet disease has frequently been cited on Prof. Bolley's authority as of bacterial origin, *e.g.*, in the last edition of Frank's (**28**) *Krankheiten der Pflanzen*, Bd. 2, p. 27, it is proper to mention it here, although the evidence for and against the bacterial nature of scab will be taken up seriatim only when we come to consider the bacterial diseases of the potato, to which the reader is referred.

5. THE ROOT-BURN OF BEETS (1894).

This disease should perhaps also be included. What little we know about its bacterial nature is derived from the brief account by Dr. L. Hiltner, in an address entitled, (**29**) Mittheilungen aus d. K. pflanzenphysiologischen Versuchsstation Tharand: Wie kann der Landwirt durch richtige Wahl, Pflege und Bestellung des Saatgutes des Krankheiten der Kulturpflanzen einigermassen verbeugen? *Sachsische Landw. Zeitschrift* 1894, No. 18, pp. 207–209.

Dr. Hiltner states that a disease called "Wurzelbrand" has caused great injury in recent years in almost all beet-growing lands. This disease appears in an early stage of growth as a more or less extensive constriction at the junction of stem and root. Subsequently there is a browning and decay of the root which proceeds from the constricted portion, and usually ends in the death of the plant. In spite of numerous investigations the cause of this disease has not been satisfactorily determined. For a long time its symptoms were confused with the gnawings of a beetle, *Atomaria linearis*, but Hellriegel, and afterwards Wimmer, showed that the disease could be preventod by soaking the beet balls for twenty hours in one-half per cent. solution of carbolic acid, and on this ground ascribes the disease to a fungus, which was believed to pass over from the beet balls to the roots of the young seedlings. Hollrung, on the contrary, found a fungus in the diseased parts of only four out of sixteen roots examined for that purpose, and ascribed the disease to

other causes, *i. e.*, to physical, chemical and mechanical peculiarities of the soil (Hiltner's account). Dr. Hiltner's own observations date from the discovery of a browning of the root hairs. He states that often in his germination experiments he had observed that a part of the root hairs on certain seedling beets would be colored brown and peculiarly shortened. When examined under a hand lens these hairs were seen to be mere brown points instead of long tubes. Seeds from a lot which germinated well, and produced seedlings that showed this browning of the root hairs to a marked degree, came up badly when planted in garden earth, and those which did grow afterwards developed the root-burn, the characteristic constriction occurring just where the sound root hairs were wanting. Hellriegel's treatment was repeated. After soaking the beet balls in a solution of carbolic acid the root hairs remained perfectly sound, and there was no subsequent root-burn. The parasite, however, is not a fungus but a bacterium. "In each epidermal cell of the root which bore a stunted hair there was to be found a specific bacterium, and to this is to be attributed the final destruction of the root." It is not stated whether the organism was isolated from the roots, or whether any infection experiments were undertaken. The context would lead one to think nothing of this sort was attempted.

RECENT LITERATURE.

Journey Through Mongolia and Thibet.[1]—This volume is 413 pages, is published in octavo form under the auspices of the Smithsonian Institution. It is an account of the travels of Mr. Rockhill in Mongolia and Thibet, based on a diary kept during the journey. The variety of subjects touched upon by the author in his descriptions of the country traversed, and the people with whom he was brought in contact, gives this volume a peculiar interest. Appendices to the diary

[1] Diary of a journey through Mongolia and Thibet in 1891 and 1892. By William Woodville Rockhill. Published by Smithsonian Institution, 1894.